The University of Texas at Austin
Hildebrand Department of Petroleum
and Geosystems Engineering
Cockrell School of Engineering

2023

ENERGY AI HACKATHON

NFL - NO FREE LUNCH

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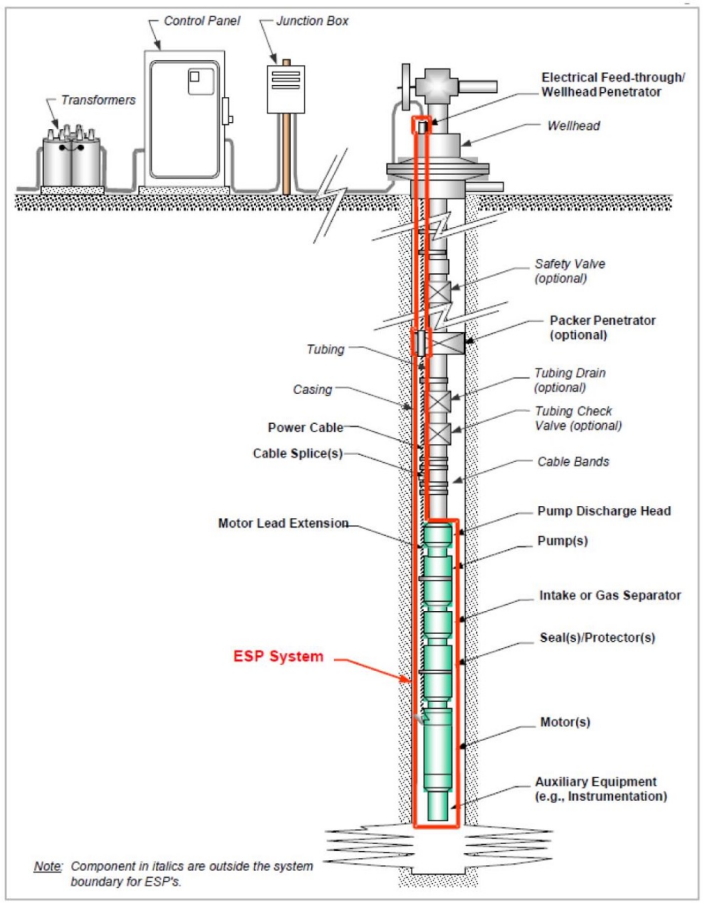
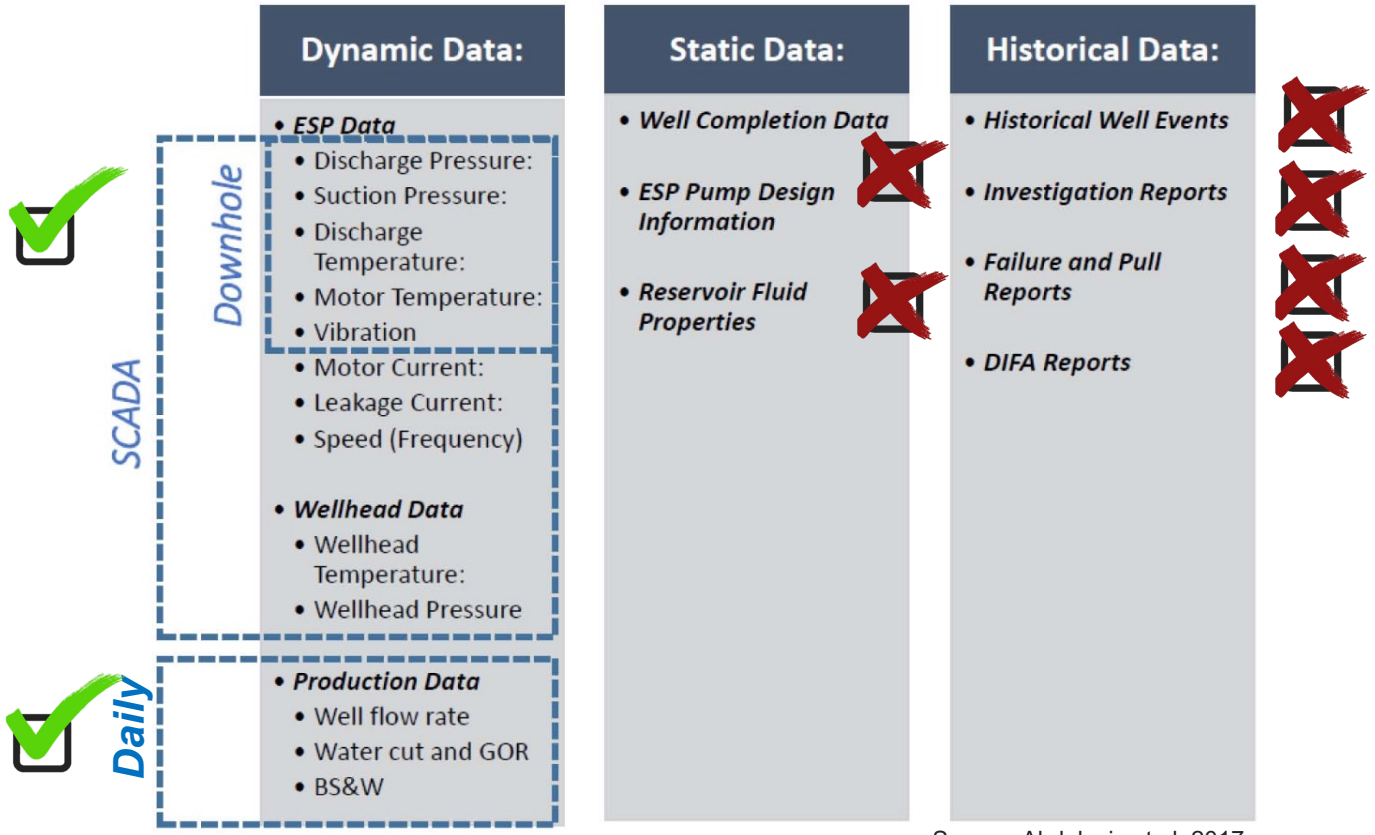
PROBLEM DESCRIPTION

Prediction / classification **"fail" or "not fail" within 30 days** for 40 artificial lift Electronic Submersible Pumps



Source: Abdelaziz et al. 2017



Source: Abdelaziz et al. 2017

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DATA PREPARATION

- Exploratory Data Analysis
- Feature Imputation
- Feature Ranking

```
# Drop columns with STR data or useless information
well_df = well_df.drop(['Unnamed: 0', 'Artificial_Lift_Type'], axis = 1)
well_solution_df = well_solution_df.drop(['Unnamed: 0', 'Artificial_Lift_Type'], axis = 1)

daily_df = daily_df.drop(['Lower_Limit', 'Power_Difference', 'Oil_Intake', 'Water_Intake', 'Gas_Saturation_at_Intake',
                          'Gas_through_Annulus_Intake','Gas_through_ESP_Intake', 'Gas_through_Annulus',
                          'Gas_Saturation_at_Discharge'], axis = 1)

daily_solution_df = daily_solution_df.drop(['Lower_Limit', 'Power_Difference', 'Oil_Intake', 'Water_Intake',
                                            'Gas_Saturation_at_Intake', 'Gas_through_Annulus_Intake',
                                            'Gas_through_ESP_Intake', 'Gas_through_Annulus',
                                            'Gas_Saturation_at_Discharge'], axis = 1)
```

Drop Features that can be reproduced by a combination of others features → ***Avoid Collinearity***

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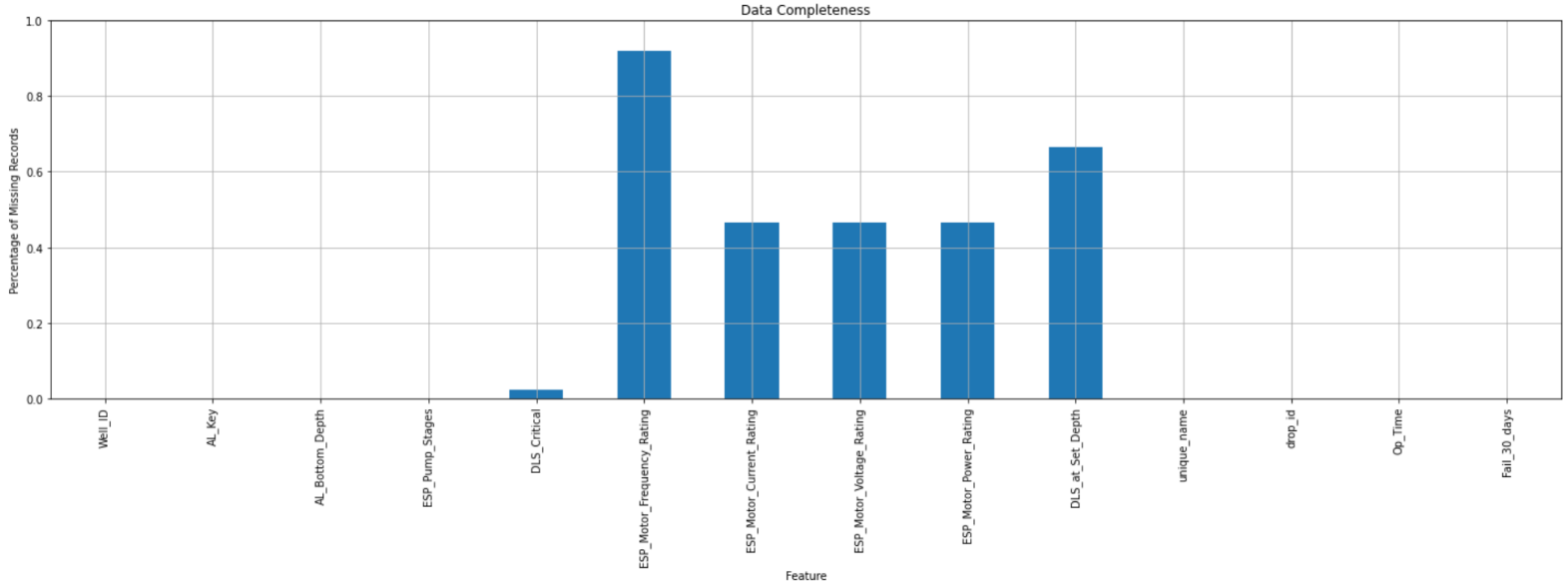
DATA PREPARATION

Exploratory Data Analysis

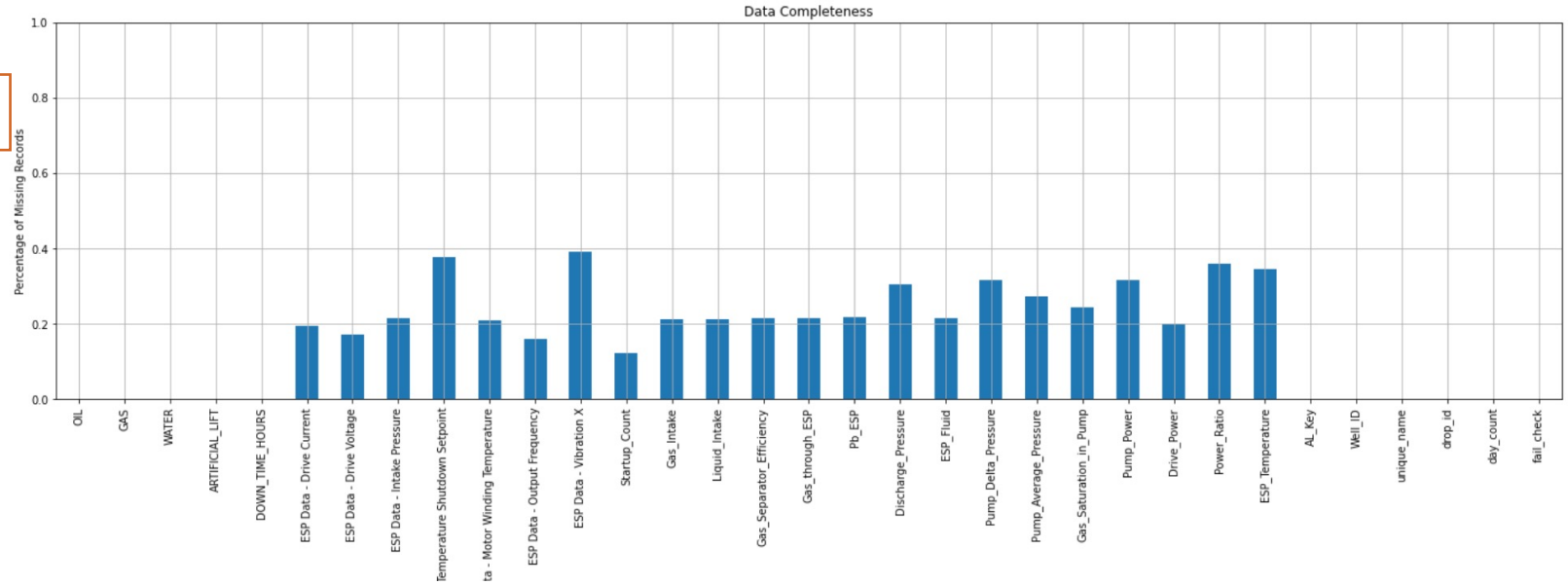
Feature Imputation

Feature Ranking

Well Data



Daily Data



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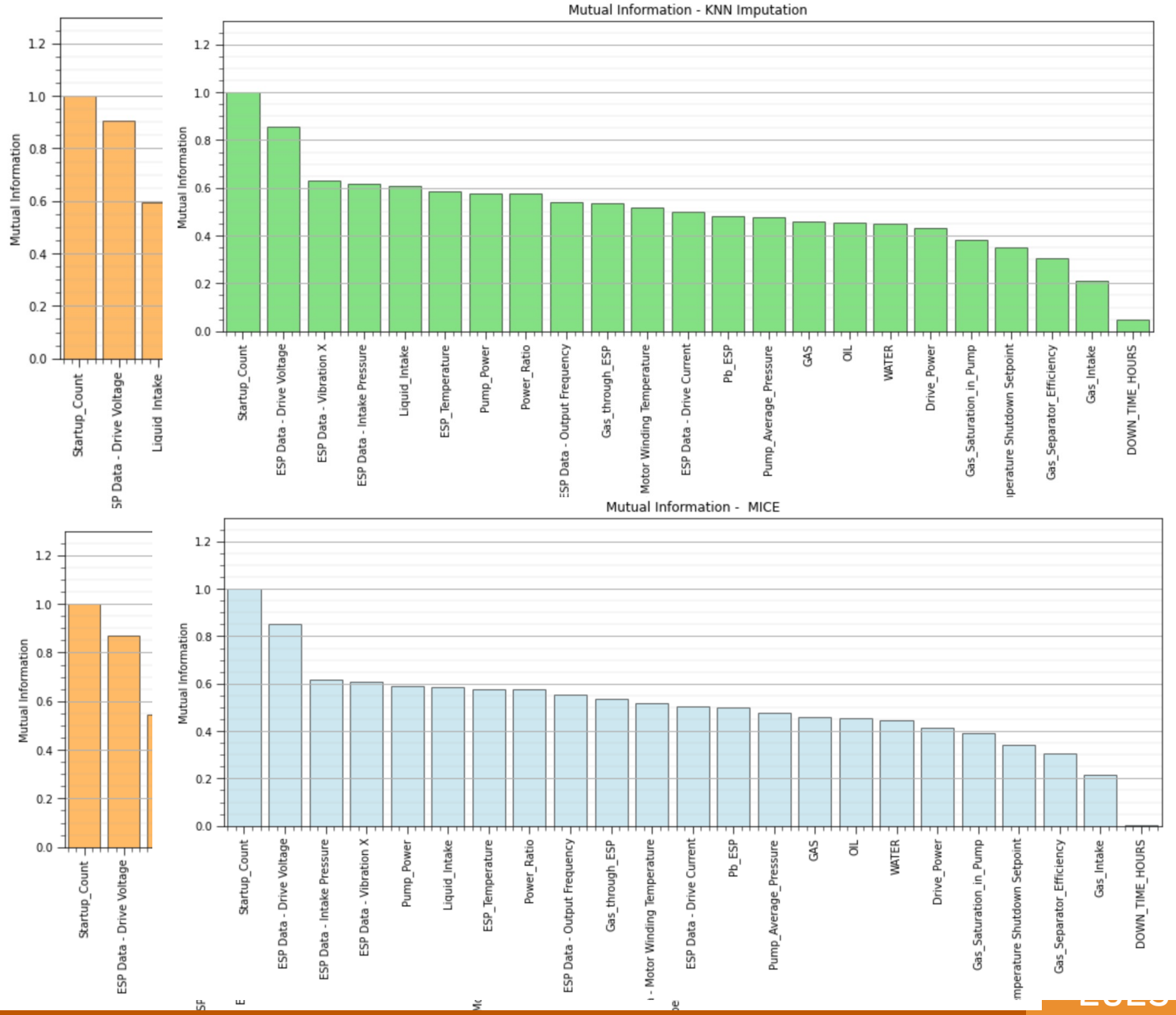
FEATURE IMPUTATION

1. Likewise Deletion
2. Replace with Mean
3. MICE
4. KNN

PCA

Mutual Information



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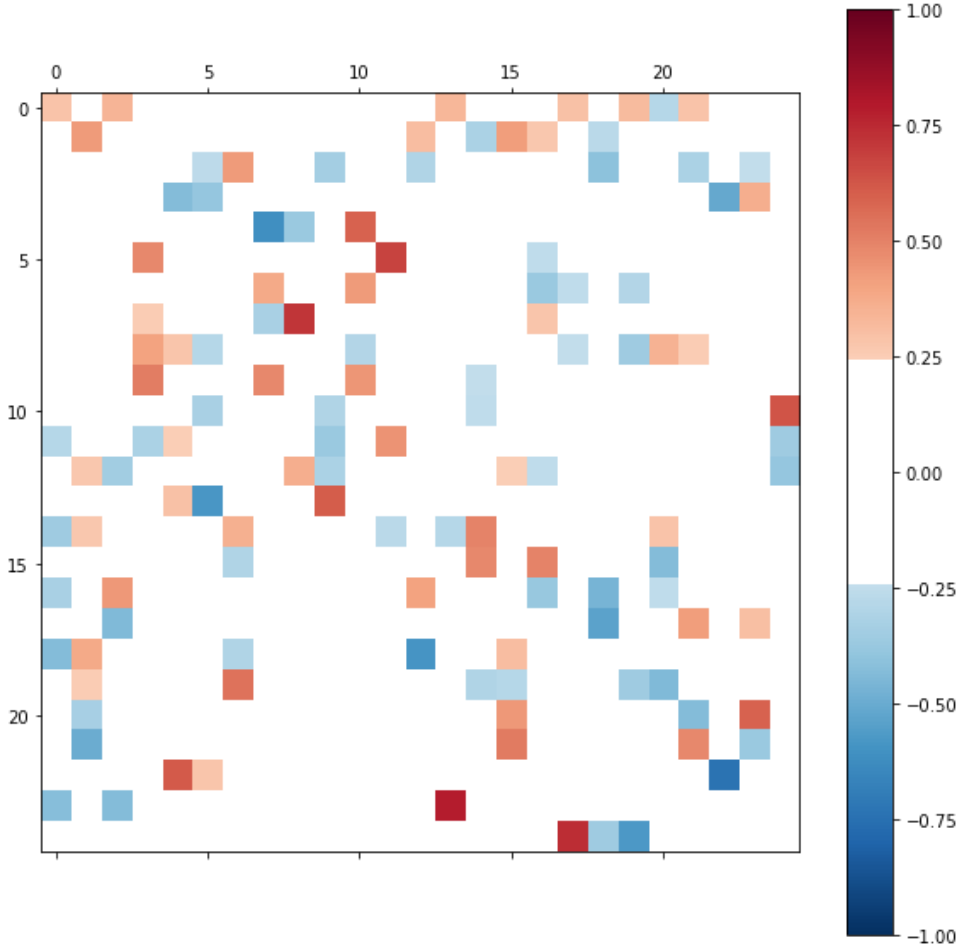
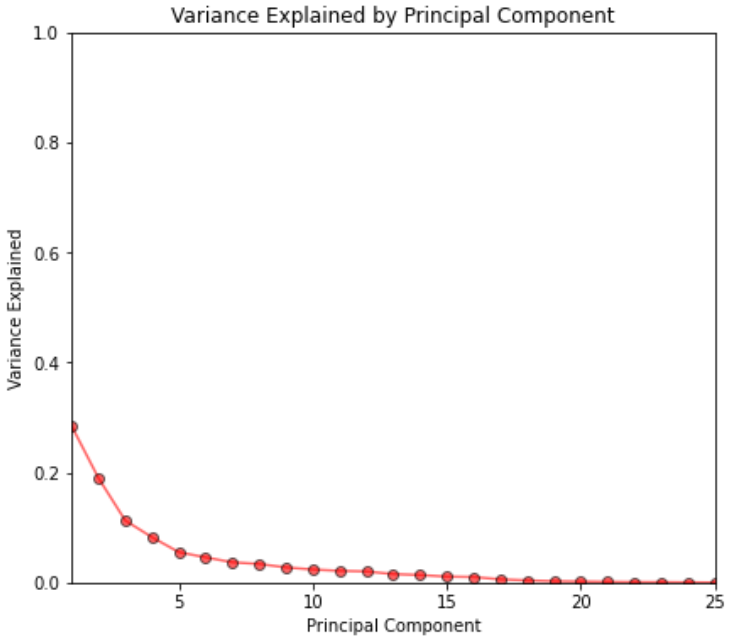
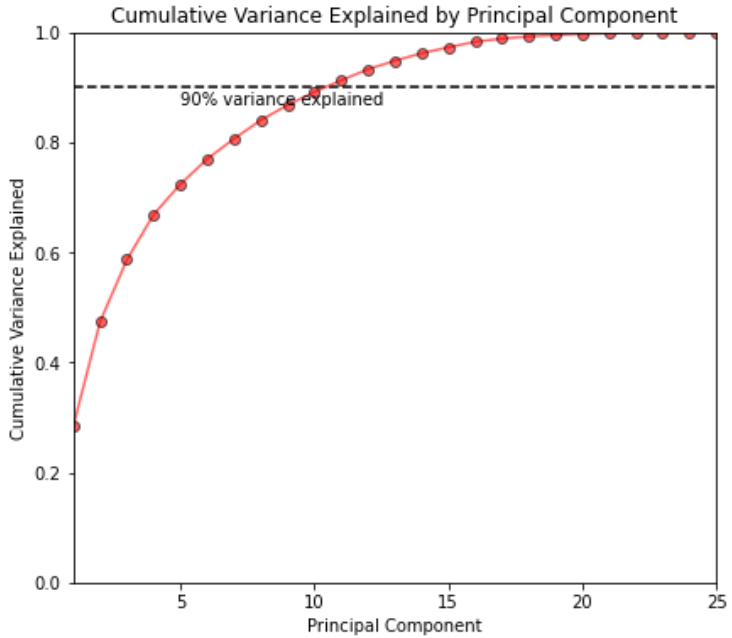
PCA Analysis







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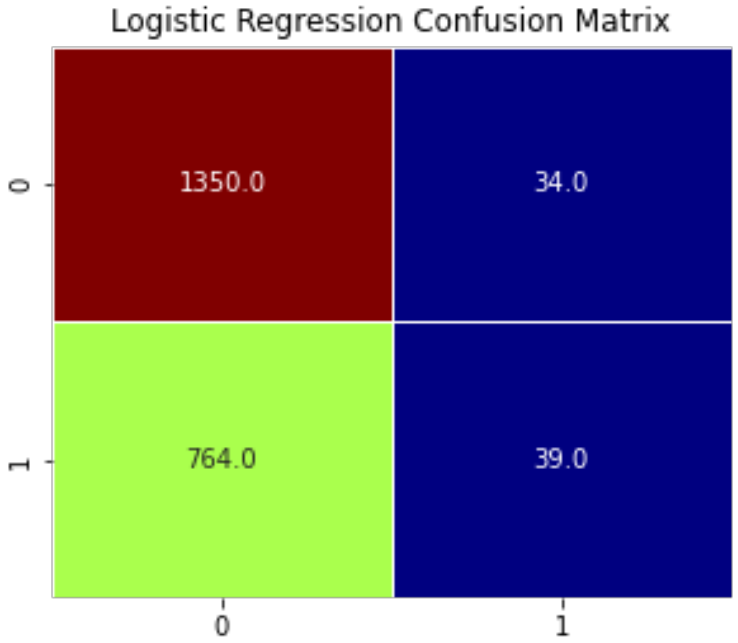
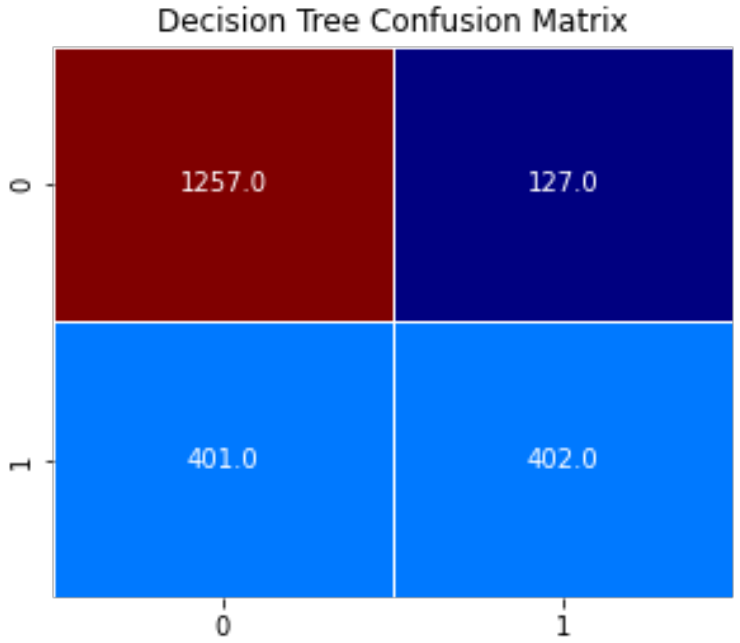
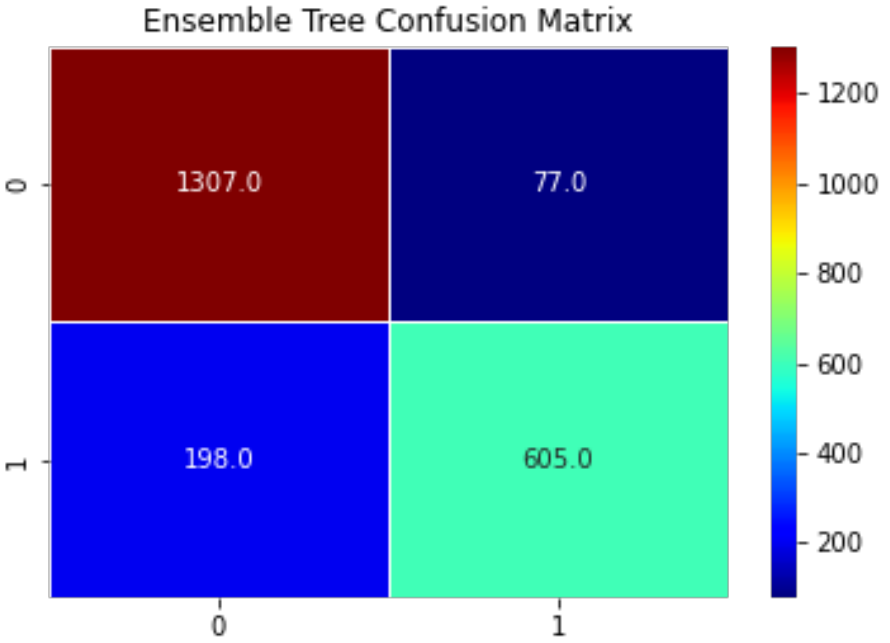
ML Models







Accuracy

0.635

Accuracy

0.759

Accuracy

0.874

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Results

Fail → *1*
No Fail → *0*

Well_ID	AL_Key	Fail in 30 days
327	ESP_1	1
125	ESP_2	0
260	ESP_3	0
21	ESP_1	1
16	ESP_1	0
20	ESP_1	0
76	ESP_1	0
60	ESP_1	1
13	ESP_1	0
10	ESP_2	1
27	ESP_1	0
105	ESP_2	0
53	ESP_2	1
84	ESP_1	0
12	ESP_1	1
113	ESP_2	0
62	ESP_1	0
25	ESP_1	0
74	ESP_3	1
7	ESP_2	0

Well_ID	AL_Key	Fail in 30 days
91	ESP_1	1
17	ESP_1	1
132	ESP_5	0
116	ESP_1	0
90	ESP_1	0
61	ESP_1	0
101	ESP_1	0
6	ESP_1	0
93	ESP_1	1
248	ESP_2	0
123	ESP_2	0
32	ESP_1	0
269	ESP_1	1
129	ESP_1	0
139	ESP_1	1
254	ESP_1	1
253	ESP_1	0
95	ESP_1	0
258	ESP_1	0
44	ESP_1	1

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